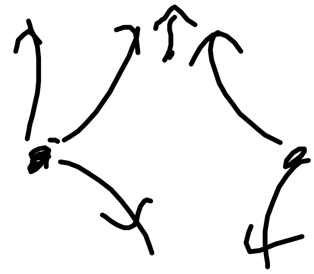
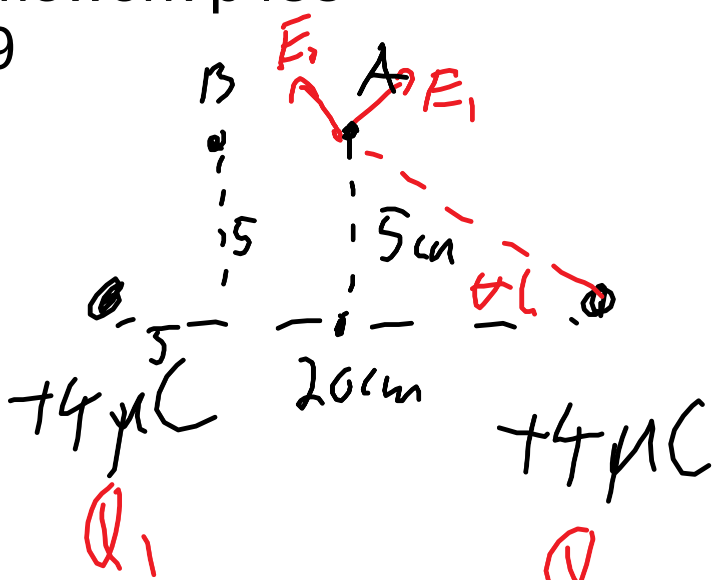
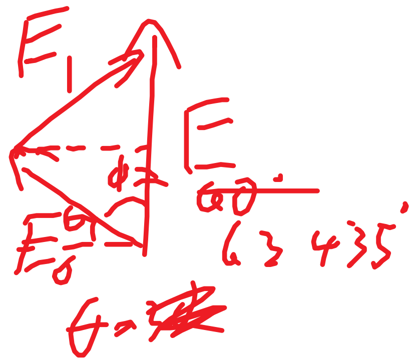
Monday, January 15, 2018 10:04 AM

Electrostatic Potential, V



Homework p438 Q19





$$E_2 = \frac{kQ_2}{r^2}$$

$|E_1| = |E_2|$ symmetry

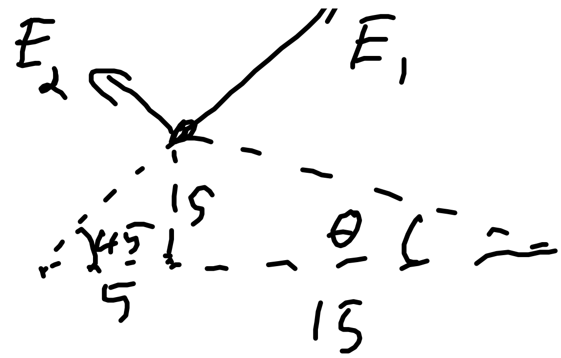
$$E = 2E_1 \cos\phi$$

$$E = \frac{2 \times 9.0\times10^9 \times 4\times10^{-6} \cos 63.435}{(0.10^2 + 0.05^2)}$$ ← $r^2 = r_x^2 + r_y^2$

$$E = 2.58\times10^6 \frac{N}{C}$$

B

D



$\theta = \tan^{-1}\frac{5}{15}$

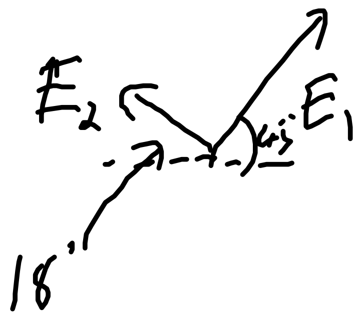
$\theta = 18.435°$

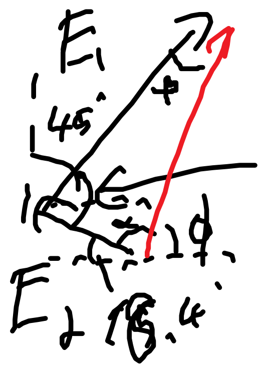
$$E_1 = \frac{KQ_1}{r_1^2} = \frac{8.99\times10^9 \; 4\times10^{-6}}{(0.05^2 + 0.05^2)}$$

$$= 7.192\times10^6 \; \frac{N}{C}$$

$$E_2 = \frac{8.99\times10^9 \; 4\times10^{-6}}{(0.05^2 + 0.15^2)}$$

$$= 1.44\times10^6 \; \frac{N}{C}$$





$45 + 18.4°$
$= 63.4°$

$$b^2 = a^2 + c^2 - 2ac\cos B$$

$$E^2 = (7.2\times10^6)^2 + (1.44\times10^6)^2 -$$

$$2(7.2\times10^6)(1.44\times10^6)\cos 63.4°$$

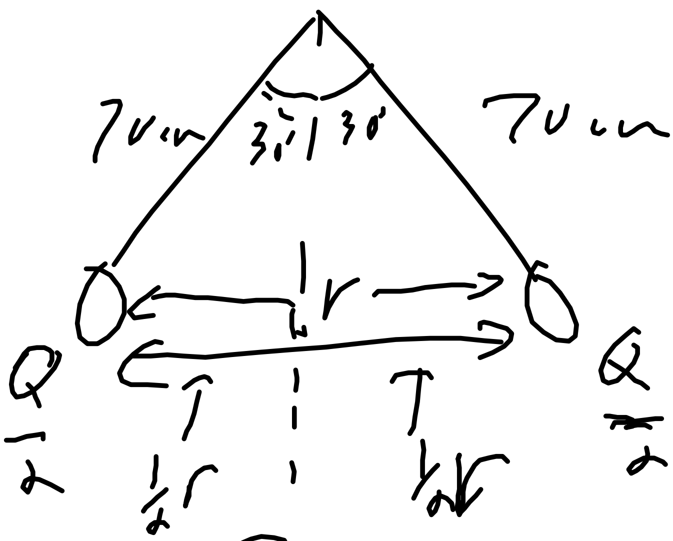
$E = \boxed{6.7\times10^{6}\ \frac{N}{C}}$

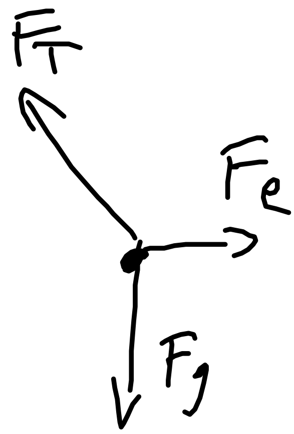
$\frac{\sin\alpha}{7.2\times10^{6}} = \frac{\sin 63.4}{6.7\times10^{6}}$

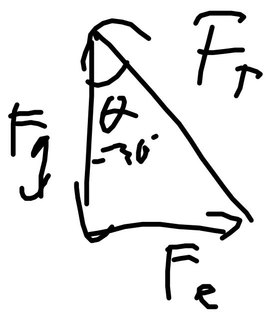
$\alpha =$

Asin(7.2xSin(63.4)/6.7)=73.92129670075712

180-18.4-73.9=87.7 ambiguous?
180-73.9=106.1
so 180-18.4-106.1=55.5º above horizontal towards Q2







$\tan 30° = \frac{F_e}{F_g}$

$\tan 30° = \frac{kQq}{r^2 mg}$

$\sin\theta = \frac{\frac{1}{2}r}{L}$

$r = 2(0.70\sin 30°)$

$r = 2(0.70 \sin 30)$

$$\tan 30° = \frac{8.99\times10^{9}\,\frac{Q}{2}\frac{Q}{2}}{0.7^2(0.028)(9.81)}$$

$r = 0.70\,m$

$Q =$

Sqrt(0.7^
4x2x0.028x9.81xTan(30)/(8.
99E9))=
2.91047878294068E-6
2.9×10^{-6}C or 2.9 μC is the
total charge on the balls

Electrostatic Potential Energy E_e (not to be confused with E, field strength) and Electrostatic Potential (different!!!!!) also called Voltage, V

Potential energy -
recall gravity
Eg = -GMm/r relative to zero at infinity, work done moving masses M and m to a distance r apart from infinity
or

$E_g = mgh$ - work done moving mass m to a height h from a reference point. assuming g is uniform over height h

guess the equations for electrostatics:

E_e = ~~-~~kQq/r   good guess but not negative because electrostatics is repulsive for like charges

$E_e = kQq/r$ work done moving charges Q and q to a distance r apart

for uniform field E
$E_e = qEd$ work done moving positive charge q in an electric field E a displacement d opposite the direction of field

Voltage/Potential V,
the electrostatic energy per unit charge
$V=E_e/q$

$\Delta E_e = Vq$

around a point charge, Q

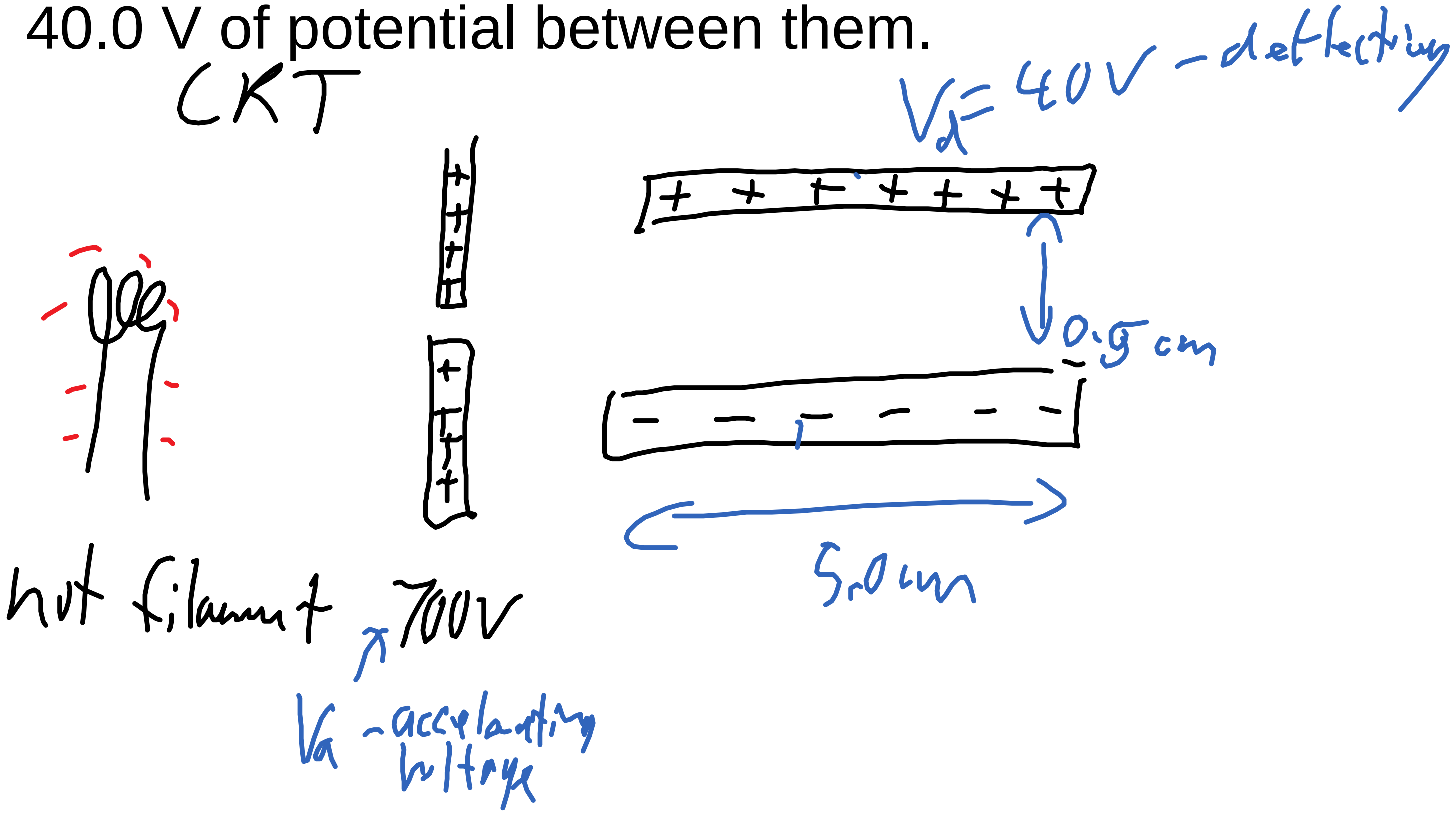
$V=kQq/r/q = kQ/r$

in a uniform field
$V=qEd/q = Ed$
or $E = V/d$

eg. an electron in a Cathode ray tube is accelerated through 700V (hot filament and a positively charged plate with a hole in it)

a) What is the change in electrostatic energy of the electron?
b) What is the velocity of the electron after the acceleration?

The electron then passes through two parallel plates, 0.500 cm apart and 5.00 cm long with 40.0 V of potential between them.



c) what is the electric field strength between the parallel plates?
d) What is the force on the electron due to the deflecting voltage?
e) what is the deflection of the beam of electrons as it leaves the deflecting plate?

Wednesday, bring labbooks pre-read p75-80
- no potentiometer step between A2 and K.